



## U.S. ARMY CHEMICAL MATERIALS AGENCY

### Incineration Technology:

*So, just what exactly comes out the stack?*

The U.S. Army Chemical Materials Agency (CMA) protects and safely stores the nation's aging chemical weapons, while working toward the effective recovery, treatment and ultimate elimination of the nation's chemical warfare materiel and to enhance national security. To eliminate chemical warfare agents, CMA uses a variety of technologies approved by oversight and regulatory agencies, such as the National Academy of Sciences' National Research Council (NRC) and the U.S. Centers for Disease Control and Prevention (CDC).

Incineration technology is used by CMA to eliminate chemical agents, such as nerve agents GB and VX, and mustard or blister agent HD. The stack, usually more than 100-feet tall, is the single feature hardest to miss at facilities that use incineration technology. It is where the facility's incineration emissions are released after they pass through an extensive pollution abatement system, which is designed to cleanse emissions that result from the disposal process. People often ask about this stack — more specifically about what comes out of it.

Before discussing what comes out the stack, let's outline what goes into the incineration process.

#### What goes in?

The primary thing that enters a chemical weapons disposal process is the chemical munition or container. One of three different liquid agents — nerve agents GB and VX and mustard or blister agent HD — are contained in aluminum rockets, steel artillery shells, bombs, land mines, spray tanks and/or large steel containers. Most of these munitions also contain explosives. In addition to agent and explosives, rockets also contain propellant, fuzes and bursters.

Incineration of chemical munitions is a proven and mature method of disposal, used primarily when chemical agent is contained in munitions like bombs, mines, rockets, projectiles and spray tanks. Basically, the process separates the key components of the chemical munition; i.e., liquid agent, metal parts and explosives, and places them into separate furnaces.

Incinerators used in the process operate at significantly higher temperatures and for longer periods of time than industrial incinerators to ensure complete destruction of chemical agent and total decontamination of casings and munition pieces. Gases from incinerator furnaces pass through a pollution abatement or removal system to further cleanse emissions. As a final safeguard, emissions are once again monitored to make sure agent is completely destroyed.

Incineration technology was used successfully at Johnston Atoll Chemical Agent Disposal System (JACADS), a pilot facility that was located about 800 miles southwest of Hawaii and completed its agent destruction operations in 2000. Lessons learned at JACADS are used to benefit the eight other CMA disposal sites, especially the four baseline incineration technology sites: Anniston Army Depot, Ala.; Pine Bluff Arsenal, Ark.; Deseret Chemical Depot, Utah; and Umatilla Chemical Depot, Ore.

#### What comes out?

The most noticeable items to exit the disposal process are steel munition bodies. These steel bodies have been treated at high temperatures to destroy any residual agent left over after the agent is drained; they are eventually recycled. Ash from the incineration of the explosives, along with the fiberglass rocket bodies and

For more information,  
contact the CMA Public  
Affairs Office at  
(410) 436-3629  
(800) 488-0648

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small metal parts from the detonators, are sent to state and Environmental Protection Agency (EPA)-approved hazardous waste landfills. A glass-like slag material forms in the same furnace that destroys the chemical agent. The slag also is sent to a hazardous waste landfill.

Hot gases from the incineration process that enter into the pollution abatement system are cooled and treated to remove industrial pollutants such as acid gases and particulates by mixing the gases with sodium hydroxide and water. This creates a clean vapor stream that exits the stack, and a salty liquid referred to as "brine." The liquid brine is sent to a hazardous waste landfill or to a commercial waste treatment facility. The vapor stream is monitored to ensure it meets stringent permit parameters and all environment regulations and guidelines before it is released out of the stack.

### **Ensuring Safe and Environmentally Responsible Operations**

Because chemical agents are unique, the Office of the Surgeon General created a blue-ribbon panel to determine health standards for working with and around the chemical agents. These standards have since been adopted by the EPA and apply to the chemical weapons disposal program. Congress and the EPA have created a number of standards that must be met; these standards are contained in such laws as the National Environmental Policy Act (NEPA), the Resource Conservation and Recovery Act (RCRA), the Clean Air Act (CAA) and the Clean Water Act (CWA). Individual states can also create their own laws that can be tougher than the federal requirements. These state regulatory agencies, not the Army, permit disposal facilities to operate and specify the standards that must be met.

Incinerators in a chemical weapons disposal plant have been specially designed to meet safety and environmental standards—ensuring that what goes out the stack is safe to the workers, public and the environment. Each incinerator is designed to ensure that the right temperature and the right amount of oxygen are used to achieve

efficient combustion—critical in ensuring safe air emissions. Afterburners or secondary chambers are added to ensure thorough treatment of material fed into the incinerators. Finally, a pollution abatement system is added to clean and cool the incinerator exhaust gases by neutralizing acid gases and trapping particulates.

Agent monitors sample exhaust gas from each incinerator and monitor to a level that is five times safer than the level that has been determined by the U.S. Surgeon General to be safe for release. Combustion monitors on each incinerator or furnace system help ensure the safety of workers, the community and the environment by monitoring the concentrations of certain gases, such as oxygen and carbon monoxide—good indicators of overall combustion performance—to ensure that the combustion process remains within the most efficient combustion limits. Temperature of the incinerators or furnaces are monitored and controlled to ensure that they remain within efficient and safe combustion limits. If any of the monitors detect unsafe conditions, the waste feed to that incinerator is immediately stopped.

The Army designed its systems to handle a very specific waste—liquid chemical agents. The Army's facilities are designed to achieve the highest levels of safety and environmental protection while disposing of the chemical stockpile. The NRC, the EPA and the Henry L. Stimson Center have recognized the Army's chemical weapons incineration process as being extremely clean and efficient.

### **Results to date**

The Army's prototype plant known as the Johnston Atoll Chemical Agent Disposal System, or JACADS, operated successfully for 10 years to completely destroy its stockpile. As of March 2005, the Tooele Chemical Agent Disposal Facility located in Utah has successfully destroyed more than 14,600,000 pounds of chemical agent. Additionally, the Anniston Chemical Agent Disposal Facility in Alabama started operations in summer 2003 and destroyed nearly 400,000 pounds of chemical agent in its first year of operations. The results

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### Results to Date

The U.S. General Accounting Office reported: "EPA has testified that the Army's current disposal program fully complies with or surpasses EPA requirements for environmental and public health protection." The National Research Council (NRC) noted: "We believe that the incinerators with the pollution abatement system that are involved here pose no health hazard."

In a separate report the NRC said: "Operational Verification Testing has provided additional assurance that the baseline system is capable of the safe disposal of the Army's chemical stockpile." The EPA, as reported by the Henry L. Stimson Center stated: "...has publicly stated that the emissions from the Johnston Atoll agent incinerator are the cleanest of any U.S. incinerator."

from JACADS, Tooele and Anniston demonstrate that the incineration technology used at some of CMA's chemical agent disposal facilities is safe and effective.

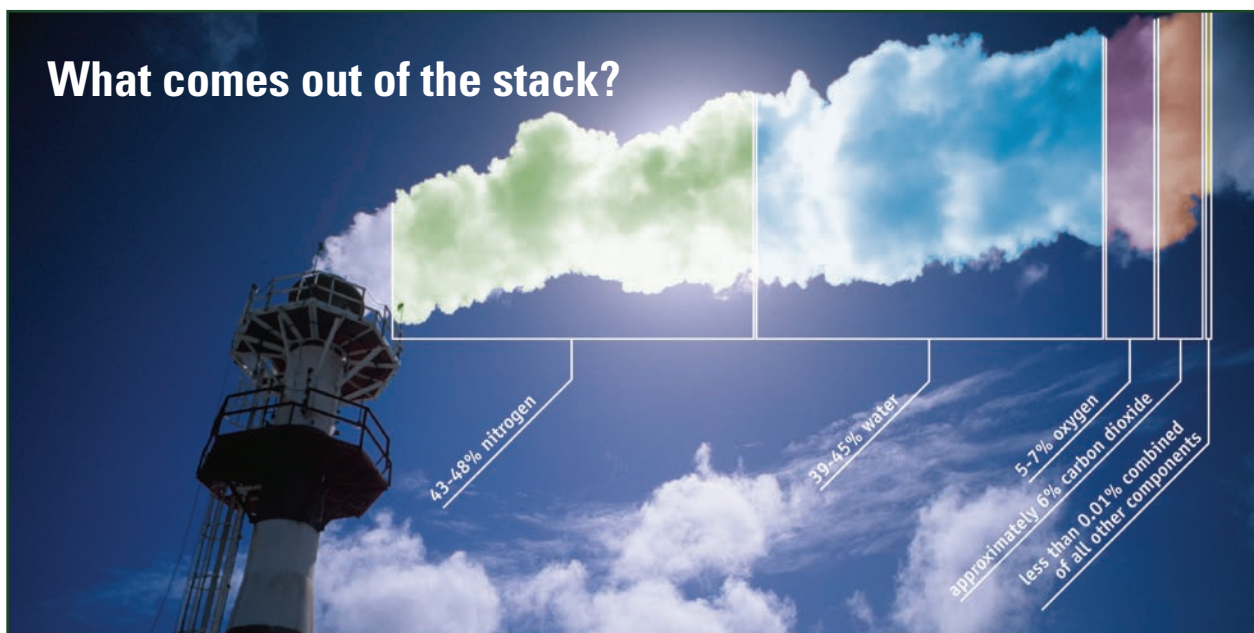
### Dioxins and furans

The trace levels of dioxins and furans contained in the exhaust gases are well below levels of concern for public health and the environment. The CDC reported: "The chemical-agent incinerators located on Johnston Atoll in the Pacific Ocean have been found to produce extremely low dioxin levels, well below levels of health concern set and regulated by the U.S. Environmental Protection Agency (EPA). In fact, the exhaust from one diesel truck, or even the smoke from a single cigarette, contains far higher concentrations of chlorinated dioxins than do the emissions from any of the Johnston Atoll incinerators."

### Ensuring ongoing operations are safe and environmentally responsible

Real-time monitoring for agent, oxygen and carbon monoxide ensures a safe process. But since some components of the gases cannot be monitored on a real-time, continuous basis, CMA also uses an EPA-approved procedure to ensure that its incinerators and furnaces are operated in a safe and environmentally responsible manner. This is done through surrogate trial burns followed by agent trial burns. In these trial burns, the systems are tested under normal operating conditions and special equipment is used to collect samples of the gases from the stack. These samples are sent to EPA-approved laboratories for careful analyses. The results of these analyses are then compared to the regulatory standards. Once approval is received that

## What comes out of the stack?





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the system operates safely, the incinerator then can be operated but only in a manner consistent with that demonstrated during the trial burns. If it isn't, the disposal process is automatically stopped. This ensures safe operations.

### **Oversight helps ensure the continuing safety of the disposal process**

A vigorous oversight program is a key element to building not only the demilitarization process but also trust with the local community. Groups such as the NRC, the Department of Health and Human Services, state and federal regulators, and citizens' advisory commissions all have oversight roles. This oversight is critical in ensuring that each step of the chemical agent disposal process is conducted with community and worker safety in mind and with good stewardship of the environment.

CMA has more than 20 years experience and a proven track record of safely treating and eliminating millions of pounds of chemical agent. Our top priority remains the safe and environmentally responsible disposal of the chemical agent weapons—safe for the workers, communities and the environment.

For more detailed and technical information on what is contained in the gases coming out the stack, please refer to CMA's technical paper "So, Just What Exactly Comes Out of the Stack?" Copies of the paper can be obtained from a local outreach office, by calling (800) 488-0648 or at the CMA Web site, [www.cma.army.mil](http://www.cma.army.mil).